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Clinical Article

Unruptured Intracranial Aneurysms with Oculomotor Nerve Palsy : Clinical Outcome between Surgical Clipping and Coil Embolization

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Objective : To evaluate the clinical outcome of coil embolization for unruptured intracranial aneurysm (UIA) with oculomotor nerve palsy (ONP) compared with surgical clipping.

Methods : A total of 19 patients presented with ONP caused by UIAs between Jan 2004 and June 2008. Ten patients underwent coil embolization and nine patients surgical clipping. The following parameters were retrospectively analyzed to evaluate the differences in clinical outcome observed in both coil embolization and surgical clipping : 1) gender, 2) age, 3) location of the aneurysm, 4) duration of the symptom, and 5) degree of ONP.

Results : Following treatment, complete symptomatic recovery or partial relief from ONP was observed in 15 patients. Seven of the ten patients were treated by coil embolization, compared to eight of the nine patients treated by surgical clipping (p = 0.582). Patient's gender, age, location of the aneurysm, size of the aneurysm, duration of symptom, and degree of the ONP did not statistically correlate with recovery of symptoms between the two groups. No significant differences were observed in mean improvement time in either group (55 days in coil embolization and 60 days in surgical clipping).

Conclusion : This study indicates that no significant differences were observed in the clinical outcome between coil embolization and surgical clipping techniques in the treatment of aneurysms causing ONP. Coil embolization seems to be more feasible and safe treatment modality for the relief and recovery of oculomotor nerve palsy.

KEY WORDS : Oculomotor nerve palsy · Intracranial aneurysm · Surgical clipping · Coil embolization.

INTRODUCTION

Most of unruptured intracranial aneurysms (UIAs) remain asymptomatic. But, some patients with UIAs may present with cranial nerve palsy[29,34]. Oculomotor nerve palsy (ONP) is a well-known symptom associated with intracranial aneurysm commonly co-existing with posterior communicating artery (P-com) aneurysm[8,10,11,30,31,39]. The most common cause of secondary ONP is diabetic neuropathy, and another common cause is compression of the nerve by an intracranial aneurysm[1,15,28]. The incidence of ONP associated with intracranial aneurysm is reported to be about 13.8%[27,30]. The possible mechanisms of ONP secondary to intracranial aneurysm are; 1) Direct compression of oculomotor nerve by an aneurysmal mass, 2) Pulsating effect of the aneurysm, 3) Irritation by subarachnoid hemorrhage, lastly 4) A combination of the above mechanisms[9,30]. ONP caused by intracranial aneurysm compromises the patient's quality of life, and it also may be a warning sign of impending rupture of aneurysm[25,37]. Thus, the unruptured intracranial aneurysm with ONP necessitates immediate treatment measures.

Surgical clipping has been a standard treatment in the intracranial aneurysm with ONP. Recovery of ONP is also observed following coil embolization in a few cases[3,6,12,32]. However, the benefit of coil embolization for the recovery of ONP compared to surgical clipping is still controversial. We retrospectively reviewed the clinical data of 19 patients reported with ONP caused by UIAs to compare and evaluate the

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efficacy of coil embolization.

MATERIALS AND METHODS

Between January 2004 and June 2008, 250 cases of UIAs were treated with surgical clipping (n = 66) and coil embolization (n = 184) at our institution. Among these, a total of 19 patients had reported with ONP caused by UIAs and treated either with coil embolization or surgical clipping. In our study, data of all the 19 patients were included, of which 15 were female and 4 were male patients (M : F = 2 : 8 in coiling, M : F = 2 : 7 in clipping). The mean age in endovascular patient group was 55.8 years (range 36-76 yrs), and that of the surgical group was 51.7 years (range 23-76 yrs). There were no significant demographic differences between the two groups (Table 1). Follow-up data obtained by patient medical files, clinical presentation, ophthalmologic examination records and angiographic results were reviewed retrospectively. The mean follow-up period was 22 months (range 8-38 months).

The inclusion criteria for this study were as follows : 1) patients with demonstrable ONP, 2) presence of an aneurysm on conventional angiography that could explain the ONP, 3) the aneurysm to be unruptured, 4) minimum of one clinical follow-up over 6 months and 5) patients to be excluded of diabetic neuropathy.

Degree of ONP was classified as complete or partial palsy. Complete ONP was defined as presence of diplopia, ptosis, opthalmoplegia and papillary dysfunction. Partial ONP had partial impairment of extraocular movement with pupillary sparing. Complete palsy was seen in 14 of the 19 patients and the others had partial palsies. On the basis of conventional angiography, locations of aneurysms were posterior communicating artery (n = 14), superior cerebellar artery (n = 1), petrous internal carotid artery (n = 1), persistent trigeminal artery (n = 1), posterior cerebral artery (n = 1), and anterior choroidal artery (n = 1). Thirteen of the 19 aneurysms were small (< 10 mm) in size and 6 aneurysms were large (≥ 10 mm). There were no significant differences in the selection of treatment modality according to degree of ONP (p = 0.629), location of aneurysm (p = 0.303), size of aneurysm (p = 0.141), and duration of symptom prior to treatment (p = 1.000) between the two groups (Table 1).

We provided a clear explanation of both treatment options to all of the patients. The decision by patients for choosing the treatment modality was taken into consideration. Clinical outcomes were categorized as response and no response. Complete symptomatic recovery and partial relief were included in response group, and unchanged symptom was defined as no response group. In response group, we subdivided the functional recovery into complete and partial recovery. Complete resolution of diplopia and ptosis, full range of extraocular movement and recovery of pupillary reaction were the criteria for complete recovery.

Improvement time was calculated from start date of treatment to the day when first improvement of ONP was detected. After discharge from hospital, follow-up the patients were continued and the day of first detection of improvement was also recorded.

Statistical analyses were performed using SPSS statistic software (12.0K). Fisher's exact test and Chi-square test were used to compare the difference of parameter and clinical outcome in each group. A p value of less than 0.05 was considered significant.

Table 1. Demographic summary of patients

	No. of patients		p value
	Coil Embolization	Surgical Clipping	
Sex			1.000
M	2	2	
F	8	7	
Mean age (yr)			0.370
< 60	6	3	
≥ 60	4	6	
Location of Aneurysm			0.303
P-com	6	8	
Others	4	1	
Size of Aneurysm (mm)			0.141
< 10	5	8	
≥ 10	5	1	
Duration of symptom (day)			1.000
< 14	7	6	
≥ 14	3	3	
Degree of ONP			0.629
Complete ONP	8	6	
Partial ONP	2	3	

Statistical analyses by Fisher's exact test

RESULTS

The demographics and clinical outcome of 19 patients in two groups are detailed in Table 2 and 3. In the coil embolization group, 6 aneurysms were P-com aneurysms and 4 aneurysms were others. Mean duration of symptom before treatment was 10.1 days (range 5-24 days). Eight patients suffered from complete palsy while 2 patients suffered from partial palsy. In surgical clipping group, 8 aneurysms were P-com aneurysms and one aneurysm was other type. Mean duration of symptom before treatment was 6.1 days (range 3-10.5 days). Six patients suffered from complete palsy and 3 patients suffered from partial palsy.

Overall, 15 patients (78.9%) responded to treatment and 4 patients (21.1%) remained unresponsive to treatment. On the last follow-up examination, 7 patients had recovered in coil embolization group (70%, complete recovery in 6 patients, partial recovery in 1 patient) and 8 patients recovered in the surgical clipping patients (88.9%, complete recovery in 6 patients, partial recovery in 2 patients). There were no statistically significant differences in clinical outcome and rate of complete recovery between these two groups (p = 0.582 and 1.000) (Table 4, 5).

In this study, ptosis was the earliest symptom to recover followed by extraocular motor dysfunction and pupilary dysfunction. The mean improvement time was similar between the two groups, viz. 50 days in coiling (range 7-90 days) and 66 days in clipping (range 3-180 days).

There were no significant differences in the clinical outcomes between two groups with regard to size of aneurysms (p = 0.557), location of aneurysms (p = 0.272), duration of symptom (p = 0.071) and degree of oculomotor nerve palsy (p = 1.000) (Table 6).

On the last clinical follow-up examination, there were no complications related to either of the procedures.

DISCUSSION

The decision on implementation of a treatment modality in UIAs still remains to be a controversial topics despite of many concerns[2,29,34]. Once the unruptured intracranial aneurysms have symptomatic and starts to display events such as mass effect, cranial nerve deficit, embolic phenomenon then these could be important indications for necessitating treatment[2,7,9,22,29,34]. Traditionally, oculomotor nerve palsy has been regarded as an indicator for instituting urgent treatment to maximize the potential of functional recovery and preventing subarachnoid hemorrhage[15,23,25].

ONP is a well-known presentation of intracranial aneurysm. The most common cause of secondary ONP is diabetic neuropathy and the next common cause is intracranial aneurysm[1,15,28]. The incidence of ONP according to intracranial aneurysm is reported to be about 13.8%[27,30], while isolated ONP can be a presenting feature of ruptured P-com aneurysm that reported frequency varies from 34 to 56%[27,30,38]. The commonest aneurysm causing ONP is P-com aneurysm, but

Table 2. Demographics and clinical outcomes in coil embolization patients

No	Age (yrs)	Sex	Location of aneurysm	Size (mm)	Duration of ONP (day)	Degree of ONP	Improvement time (day)	Clinical outcome
1	62	F	P-com	6.0	16	Complete	90	CR
2	72	F	P-com	6.0	5	Complete	60	CR
3	76	F	P-com	8.5	6	Complete	-	NR
4	46	F	P-com	5.0	2	Complete	7	CR
5	65	F	Others	18.0	10	Complete	90	CR
6	36	M	Others	24.0	9	Complete	60	PR
7	45	F	Others	20.0	30	Partial	-	NR
8	54	M	Others	17.0	20	Complete	-	NR
9	44	F	P-com	13.6	2	Complete	15	CR
10	58	F	P-com	9.5	1	Partial	18	CR

CR : complete recovery, NR : no response, p-com : posterior communicating artery, PR : partial recovery, - : uncheckable

Table 3. Demographics and clinical outcomes in surgical clipping patients

No	Age (yrs)	Sex	Location of aneurysm	Size (mm)	Duration of ONP (day)	Degree of ONP	Improvement time (day)	Clinical outcome
1	65	F	P-com	10.5	7	Complete	30	CR
2	50	F	P-com	7.0	10	Complete	30	CR
3	55	M	P-com	5.0	2	Partial	3	CR
4	62	F	P-com	4.0	15	Partial	90	CR
5	23	F	P-com	7.0	7	Complete	180	PR
6	76	F	P-com	5.0	12	Complete	15	PR
7	66	F	P-com	6.0	50	Complete	-	NR
8	60	M	Others	3.0	15	Partial	90	CR
9	60	F	P-com	7.3	6	Complete	90	CR

CR : complete recovery, NR : no response, p-com : posterior communicating artery, PR : partial recovery, - : uncheckable

Table 4. Summary of clinical outcomes by procedure

	No. of patient (%)		Total
	Response	No Response	
Coil Embolization	7 (70.0)	3 (30.0)	10
Surgical Clipping	8 (88.9)	1 (11.1)	9

p = 0.582, statistical analyses by Chi-Square test

Table 5. Summary of rate of complete recovery in response group by procedure

	No. of patient (%)		Total
	Complete recovery	Partial recovery	
Coil Embolization	6 (85.7)	1 (14.3)	7
Surgical Clipping	6 (75.0)	2 (25.0)	8

p =1.000 statistical analyses by Chi-Square test

Table 6. Prognostic factor of clinical outcome regardless of procedure

	No. of patients		*p* value
	Response	No response	
Sex			1.000
M	3	1	
F	12	3	
Mean age (yr)			1.000
< 60	7	2	
≥ 60	8	2	
Location of aneurysm			0.272
P-com	12	2	
Others	3	2	
Size of aneurysm (mm)			0.557
< 10	11	2	
≥ 10	4	2	
Duration of symptom (day)			0.071
< 14	12	1	
≥ 14	3	3	
Degree of ONP			1.000
Complete ONP	12	3	
Partial ONP	4	1	

Statistical analyses by Fisher's exact test

rare cases of other aneurysms are also reported[20,24,33,35,36]. The mechanisms by which intracranial aneurysm lead to ONP are as follows : 1) direct compression of oculomotor nerve by aneurysmal mass, 2) pulsating effect of the aneurysm, 3) irritation caused by subarachnoid hemorrhage, and 4) combination of all the above mechanisms[3,9,30]. The anatomical relationship of the P-com and the oculomotor nerve could explain the reason for compression of the nerve[3,15,30].

The clinical presentations of ONP, caused by intracranial aneurysm are orbital pain, headache, ptosis, mydriasis, external ocular movement dysfunction and diplopia. Painful ONP may be a definite warning sign of impending rupture of aneurysm[15,25].

Surgical clipping has been the gold standard in the treatment of ONP secondary to intracranial aneurysm and its efficacy has been reported in many published report[7,9,11,22,30,31]. Giombini et al.[9] described 49 patients with intracranial aneurysm presenting ONP who were treated with surgical clipping and reported their successful results. The mechanism of recovery by surgical clipping is known to be effective by relieving the mass effect.

Keeping up with the recent developments in neurointerventional techniques since 1990s, endovascular coiling has been in widespread use for the treatment of intracranial aneurysm[3,4,12,14,16,17,19,32]. ONP caused by intracranial aneurysm has been reported to resolve after coil embolization in a few published data. Birchall et al.[3] reported that patients with ONP caused by P-com aneurysms recovered within 2 to 3 weeks after endovascular treatment, suggesting an earlier resolution of ONP than surgery. The mechanism of recovery by coil embolization still remains to be uncertain, but the loss or decrease of aneurysmal pulsation may be a important mechanism in the recovery of ONP[3,26,30]. Kerns et al.[18] has also demonstrated that a complete recovery does not necessarily need full anatomical normalization. In this study, we would attribute the loss of aneurysmal pulsation for the recovery of ONP following coil embolization.

The recovery of ONP after surgical treatment commonly takes the following course : ptosis improves frequently first with recovery generally beginning within the first month of surgery then followed by external ocular movement and then improvement in pupillary function in that order[3,8,9,21,23,37]. Unlike surgical clipping, coil embolization does not immediately remove the mass effect of the aneurysm[3].

We retrospectively compared the clinical outcomes of ONP secondary to UIAs in two demographically comparable groups of patients following coil embolization and surgical clipping. Following treatment, complete symptomatic recovery or partial relief from ONP was observed in 15 patients. Seven patients recovered in coil embolization treatment group (70%, resolved in 6 patients, improved in 1 patient) and 8 patients recovered in the surgical clipping group (88.9%, resolved in 6 patients, improved in 2 patients). In response group, ONP resolved completely in 12 patients (80%) and partially in 3 patients (20%). Six (85.7%) of seven patients with ONP experienced complete recovery after coil embolization, compared with six (75%) of eight patients treated with surgical clipping. However, there were no statistically significant difference in clinical outcome and rate of complete recovery between these two groups (p = 0.582 and 1.000) (Table 4, 5). The result of this study suggests that the efficacy of endovascular coiling is as effective as the proven surgical clipping. Therefore, endovascular coiling can be considered as an alternative choice in treatment of ONP secondary to UIA. On the other hand, Chen et al.[5)] reported that surgical clipping was associated with a higher incidence of complete recovery than endovascular treatment.

Several prognostic factors in recovery of ONP caused by intracranial aneurysm were described in earlier reports, especially on the duration and severity of symptom[5,8,9,13,21,22,27,30,37,38)]. Soni[30)] stressed that duration of symptom before treatment was a very important factor. The report described a series of cases in which all patients underwent surgical clipping within 10 days after onset of ONP experienced complete recovery within 3 months of surgery. Conversely, if duration of symptom was longer than 10 days, recovery was delayed and as many as 57% of patients had residual defects. On the other hand, Yerramneni et al.[38)] and Kyriakides et al.[21)] suggested that the severity of preoperative ONP is the most important factor of recovery of ONP associated with P-com aneurysms. In several other reports[5,9,21,22,30)], age, gender, size and location of aneurysms had no influence on the recovery of nerve deficit.

In this study, no significant differences between coil embolization and surgical clipping group were observable in the following parameters : 1) duration of ONP, 2) degree of ONP, 3) age, 4) gender, 5) size of aneurysms and 6) location of aneurysms (Table 5). Even though the differences was statistically insignificant, P-com aneurysm, small aneurysm, short duration of symptom before treatment showed favorable results in coil embolization and surgical clipping (Table 6).

CONCLUSION

In our study, both surgical clipping and coil embolization techniques have resulted in satisfactory clinical outcomes for the treatment of ONP secondary to UIAs. However, there were no significant differences in clinical outcome and incidence of complete recovery between the two treatment modalities. Thus, endovascular treatment seems to be an effective and alternative treatment modality for UIAs with ONP in order to prevent aneurysmal rupture and aid in the recovery of ONP comparable to surgical clipping. The limitation of this study is the small number of patients. Larger prospective comparative studies are needed to validate these findings.

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